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EDITED BY WATSON DAVIS

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EDWIN E. SLOSSON, Director
WATSON DAVIS, Managing Editor

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SYNTHETIC PRODUCTS MAY BREAK NITRATE MONOPOLY

In spite of the fact that ordinary air is four-fifths nitrogen, the United States is at the present time in the clutches of foreign monopolies that control the kind of nitrogen that can be used to feed America's crops, make its explosives, and furnish raw material for thousands of chemical andother industrial plants.

For nitrogen that can be used in industry and agriculture occurs naturally in workable quantities in practically only one location, Chile, and it is expensive and difficult to take the free uncombined nitrogen of the air and convert it into fixed or chemically combined nitrogen that can be used in agriculture and industry. Such American plants as those at Muscle Shoals, using methods developed at home and abroad, can successfully produce American-made nitrates.

Unlike the rubber situation, in which little relief from foreign control is in sight for a decade or more, America can easily become independent of foreign nitrate in time of need.

American crops and factories use nearly $75,000,000 worth of nitrogen in one form or another each year, and over $50,000,000 of this comes from abroad, chiefly from Chile. Other kinds come as fertilizer from factory wastes or as ammonialiquors from coal distillation in the making of gas coke. The rest is made synthetically from the nitrogen in the air by chemical means.

In 1925 the world used 857,000 tons of the element nitrogen, exclusive of that occurring in animal products or foods. Of this amount 44 per cent. comprised the nitrogen in the output of Chile saltpeter, and 56 per cent, was fixed nitrogen.

A monopoly of nitrate producers controls practically the entire output of the Chilean fields. The government of Chile is a party to the monopoly and puts a tax of $12.34 on every ton of nitrate that leaves the country. At present, the price of the nitrate, artifically boosted by the tax, sets the standard for all synthetic nitrates and fertilizers.

It is believed that when the methods for getting nitrogen from the air are further improved and more commonly used, synthetic nitrogen products will turn the tables on the Chilean fields. Recently discovered means of getting nitrogen from the air where it exists in unlimited quantities and in an explosive form, have becomeof vital importance in peace and war. By these means Germany freed herself from Chile before the war, and the United States might do the same.

As a result of nitrogen fixation it is estimated that 56 per cent. of the world's supply of inorganic nitrogen came out of the air in 1925. Before the war only 10 per cent. was gotten in that way. The plentiful supply of nitrogen which is in the air and there for the taking, may make it possible for agriculture of the future to meet the demands of the fast growing population of the world, which is disturbing the sleep of many an earnest economist. There is almost unlimited room for improvement in agriculture. The Department of Agriculture points out that in 1925, out of the forty odd millions of acres planted in cotton, only about 36 per cent. are fertilized.

"What is done with the nitrogen problem in the next ten years will go far to determine American standards of living," according to a statement of Dr. Harry A. Curtis, former chief of the nitrate division of the U. S. Department of Commerce. "Unless relatively cheap fixed nitrogen can be supplied to agriculture each acre will produce smaller crops while our population will continue to get larger."

Although the processes for getting nitrogen from the air are less than twenty years old they already give the world each year an amount greater than that shipped out of the Chilean fields. There are many possible ways of hooking up the obdurate atmospheric nitrogen with materials on earth, but only three of these ways are actually used.

The simplest of these is the electric arc process. Nitrogen is induced to combine with oxygen by the powerful stimulant of electricity. The nitric oxide formed is passed through huge absorption towers where it reacts with water and more oxygen to form dilute nitric acid. The process has been successful in Norway, but the exceedingly high electric power requirement has prevented its use in most other countries.

In the cyanamide process, which was first used in Italy, nitrogen is trapped as it passes over finely powdered calcium carbide heated to about 1000 degrees. It becomes chemically fixed into solid calcium cyanamide which can be easily changed to ammonia gas or nitric acid. The raw materials needed for making the calcium carbide are coal and limestone, and the energy required is only about one-fourth that needed for the arc process.

It was found that calcium cyanamide could be put directly into the soil as a fertilizer. This stimulated production, and in 1913 there were already nine producing countries making 172,000 tons of the substance. The production is about four times as great today.

The synthetic ammonia process, the newest of the three methods of nitrogen fixation, was not known outside of Germany when the world war began. Today, however, there are many processes based on the same principle. The pioneer Haber process was worked out mostly by Fritz Haber in Germany between 1905 and 1908. The principle involved has been alluded to as the most far-reaching accomplishment of chemical engineering.

The general features of the German patent were publicly known, but the intimate details that made it workable were secret. The American government, fearful of being cut off from Chile, set up a plant at Muscle Shoals, Alabama, to operate a modified method worked out in the United States, but did not get it into operation until the war was over. British attempts to establish synthetic ammonia plants were also unsuccessful.

After the war a number of countries set to work in desperation to solve the problem. In 1921 a way that worked was found at a plant in Syracuse, New York. Plants of various countries are now able to produce over 300,000 tons of fixed nitrogen each year, but the capacity of Germany's plants alone accounts for over 90 per cent. of the total.

This process sounds as simple on paper as any of the others but it was the hardest nut to crack. A properly proportioned mixture of nitrogen and hydrogen gas is passed over a catalyst, a substance that by some seemingly magic influence can make two unwilling elements react chemically toward one another. The combination forms ammonia. Heat is produced, and not absorbed, during this reaction and the more the temperature is kept down and the pressure up the more ammonia is evolved. A difficulty of this process is to obtain pure hydrogen and nitrogen, for impurities lessen the efficiency.

"The synthetic ammonia process is much better suited to American conditions than the arc or the "cyanamide process," Dr. J. M. Braham of the U. S. Fixed Nitrogen Research Laboratory has stated. "There are in this country enormous potential sources of hydrogen. The power requirements are small and the process does not require a large amount of labor."

NEW MACHINE SENDS CODE MESSAGES AUTOMATICALLY

If the code message in Edgar Allan Poe's famous story "The Gold Bug" had been written on the machine described recently to the American Institute of Electrical Engineers, Legrand, would not have had such an easy time deciphering it, for the age-old search for a method of putting important messages into a code which cannot be interpreted without the use of the key seems to have been achieved.

The new machine was described by G. S. Vernam, engineer of the American Telegraph and Telephone Company, who stated that it had been developed for the use of the Signal Corps of the U. S. Army during the war, but until recently it has been kept secret. However, one of the advantages of the device is that even an unauthorized person who has full knowledge of the methods and apparatus used can not interpret the message without the key.

In use, the sender writes the message on a keyboard similar to that of a typewriter, and a perforated tape results which can be used in tape transmitters frequently used in telegraph offices. By means of another kind of machine, if it is desired, the cipher message can be written directly in five letter code words on paper in ordinary characters. When the message is received, it is written on a tape in perforations, and when this is passed through the deciphering machine, the message is written out in plain text on a sheet of paper.

The method used is one involving what is referred to as a multiple alphabet substitution cipher. In the ordinary substitution cipher a cipher alphabet with the letters arranged inan arbitrary manner replaces the actual alphabet in the same order. That is,instead of starting A,B,C, etc., the cipher alphabet might start F,Q,R, etc., and in use, the letter A in the original message would become F in the cipher; B would become Q,, and so on. Such a cipher may easily be interpreted in the way Poe made famous in "The Gold Bug", by noting the letter that occurs oftenest and calling it E, which is most used in the English language.

O is the next oftenest used, with T a close third, J. X and Q being the least used.

With the multiple alphabet cipher, a series of cipher alphabets are used one after the other, the order being given by means of the key word, but the same alphabet is used over and over at regular intervals. While more difficult than the single alphabet, the cipher expert, or "cryptanalyst", can interpret such a message without the key. However, if a key as long as the message itself is used and the letters in it are selected at random, it is practically impossible to translate it. This is the system used in the machine, and the key is another tape, so that the transposing of the letters is done automatically.

As a further improvement, a way was found to obviate the use of a tape as long as the tape of the message itself. This was accomplished by using two loops of tape which combined give the key. One loop is one character shorter than the other, so that as the two tapes pass through the machine at the same rate of speed, they must go around many times before the same combinations are repeated. This gives the effect of a very long tape.

Mr. Vernam stated that the apparatus could also be used for radio, or if necessary the code tape could be sent by mail without fear of its being interpreted by an unauthorized person.

ULTRA-VIOLET LIGHT NECESSARY IF MILK IS TO PREVENT RICKETS

Batteries of quartz-tube ultra-violet lamps may become a necessity in stables where dairy cattle are fed in winter, if the experiments performed at the Maine Agricultural Experiment Station by Dr. John W. Gowen and his associates may be taken as an indication. The experiments show that milk from cows receiving a "dose" of ultra-violet light from mercury vapor lamps contains the substance that prevents rickets in children and young animals, while the milk from cows kept away from sunlight and not treated with ultra-violet light was powerless to prevent the ailment.

In the experiments, Holstein- Friesian cows of nearly the same age and calving date and receiving like treatment as to feed, temperature, etc., were placed side by side in the same barn.

"Throughout the experiment these cows did not leave the barn. For one month none of the cows received ultra-violet light. For the second month two cows received ultra-violet light fifteen minutes a day generated from a Cooper-Hewitt alternating current light at three feet above their backs. For the third month these cows received ultra-violet light for thirty minutes a day under the same conditions. In the meantime Rhode Island Red chickens were allowed to develop rickets, shown both clinically and by X-ray photographs. They were divided into two lots, one lot of three chickens receiving milk from the ultra-violet cows, the other of two chickens, milk from the control cows. Both lots received all the milk they wished.

"The chickens have now been under treatment fifty days," Dr. Gowen stated. "The lot receiving milk from cows exposed to ultra-violet light are in good condition with no appearence of rickets in X-ray plates. The lot receiving normal milk has moved progressively toward more extreme clinical and X-ray rickets. The

experiment has been repeated, using the milk from these same cows on White Leghorn chickens showing clinical and X-ray rickets. Five chickens were in each lot. After thirty-eight days treatment four of the lot receiving milk from the ultra-violet cows are almost cured of rickets, showing only a very slight stiffness. The fifth chicken shows some stiffness. Four of the lot receiving the normal milk show constantly increasing symptoms of the more advanced stages of clinical rickets.

"These results point to the conclusion that more of the substance necessary to cure rickets is absorbed by the cow exposed to ultra-violet light and secreted by her in her milk. The cows prevented from receiving ultra-violet light are not able to secrete this anti-rachitic substance in sufficient quantities to cure or allay the progress of clinical rickets. The results thus point to an environmental factor transmitted by the cow to her offspring through the medium of her milk. It further suggests that the high incidence of rickets in children during the late winter months is due to their mothers' not receiving enough ultra-violet light either during pregnancy or while in lactation. Furthermore, it would appear that cows' milk produced especially for baby feeding should be from cows which have access to ultra-violet light either from the sun or some other source."

BLOOD CELLS AND GLANDS CONTAIN CURE FOR RICKETS.

New cures have been found for rickets, a serious disease of children and young animals due to defective bone structure, in three substances commonly found in the bodies of all animals. They were reported by Dr. Andor de Bosanyi in a recent issue of the Bulletin of Johns Hopkins Hospital.

Rats afflicted with rickets were fed on a diet containing hemoglobin, which is the red coloring matter found in blood corpuscles. When the diet contained from five to six per cent. by weight of this material the rats were quickly cured of their rickets.

A previous experimenter had stated that a substance very similar to hemoglobin would cure rickets when the subject treated was exposed to light. In order to determine whether or not light had any influence in the cure caused by the hemoglobin, rachitic rats were fed the diet containing hemoglobin for eight days in a light-proof compartment. There was found to be quite as marked healing as in the presence of light.

Adrenalin, a substance secreted by glands lying immediately above the kidneys, and known to be a very powerful heart stimulant, was next given to the rats. Very weak doses were given at first and the strength of the dose increased until after four or five days the rats were taking at one dose an amount which would have proved fatal before. Healing of the rickets then began and proceeded rather rapidly until all symptoms disappeared.

The third curative substance was found in histamine, which is a decomposition product of proteins, those complex nitrogenous compounds that form the foundation of all living things. Rats on a histamine diet were cured of rickets in from six to eight days.

RECORDING SPEEDOMETER AND AUTOMATIC GEAR SHIFT TO SIMPLIFY AUTO DRIVING.

An automatic gear box for automobiles that will do away with all manual gear shifts and greatly simplify the art of driving, and a self-recording speedometer that will settle all arguments between supposed speeders and traffic officers are two of the latest Swedish inventions that have been perfected at the plant of the S. K. F. Company in Gothenburg, Sweden.

The first contrivance is the personal invention of Dr. Sven G. Wingquist, founder of the firm, and in 1921 named honorary doctor of engineering at the Stevens Institute of Technology in the United States. Exactly how it is constructed is still a secret, but from various patents granted him during the years he has been working on the problem, it has been inferred that the device utilizes both mechanical and hydraulic principles.

At any rate the new gear box has been installed in a closed motor car of American make and tested out in heavy traffic and under all possible driving conditions. It has also been shown to motor engineers in England, where it has attracted great attention. By automatically throwing into gear more and more wheels as the resistance increases and conversely taking them out as the "load" grows less, it leaves the driver free to watch the road and regulate the speed only by means of the gas throttle and brakes which reduce the risk of accidents. It also is supposed to preclude the stalling of the engine.

The self-recording speedometer has been warmly recommended by the Swedish police authorities and for the purpose of testing its workings under various conditions it has recently been installed in five different kinds of vehicles, a taxi cab, a passenger bus, a large freight truck and a light one, and a private automobile. At regular intervals the records of these five motor cars will be inspected by the police and the wear as well as reliability officially determined. Chief of Police Haarleman of Stockholm is personally interested in these tests, as he maintains that in case of accidents it is of the utmost importance to be able to determine exactly how fast each car had been travelling. So far the new speedometer has functioned perfectly in all tests.

HARVARD ASTRONOMERS STUDY MILKY WAY STRUCTURE

A hundred years ago the English astronomer, Sir William Herschel, showed that all the stars visible in the heavens formed a system the shape of a watch or a grindstone, with the sun near the center. When we look out along the diameter of the grindstone we see a great mass of stars which appear like a continuous stream of light to the unaided eye. This is the Milky Way, or "Galaxy", as the astronomer calls it; and to learn more of it, and hence of the universe of stars of which the sun and its attendant planets form such a minute part, astronomers at the Harvard College Observatory are now engaged in making an extensive series of photographs of these star clouds.

The method used depends on a fact discovered by Dr. Harlow Shapley, director of the observatory, that certain kinds of variable stars, which periodically diminish in brilliance and then grow bright again, change more rapidly, the greater their average brightness. This permits the astronomer to find out how bright they actually are. By looking at them with his telescope he can find out how bright they seem, and from the relation of the actual and apparent magnitudes he can find their distances. These stars, called Cephcid variables,

are the ones being employed in the Milky Way studies.

"The Cepheid variable stars, and to a lesser extent the long period variables, afford valuable means of measuring great distances," explains Dr. Shapley. "With the perfection of photometric methods, it becomes possible to analyze any part of the stellar system in which variables occur, outlining its extent in various dimensions and the frequencies of certain types of stars. The problem of the structure of the galactic system has been of special interest to me for several years, and we have now perfected plans to place on a systematic basis one part of the analysis of the Milky Way.

"Three belts in the galaxy are being photographed continually at Cambridge and at our branch station at Arequipa, Peru, with exposures of sufficient length to show stars to the seventeenth magnitude. Each one of the two hundred fields, which completely cover the Milky Way, will be photographed over a period of four or five years from five to forty times annually. The accumulated material will be sufficient, in general, to determine the light variations of all variable stars to the sixteenth magnitude, or fainter. More than a hundred new variable stars have already been found during the early stages of this work. We are particularly able to do this for we have suitable telescopes and an extensive collection of early photographs, and our staff has had long experience in measuring stellar brightnesses."

The first photographs ever made of stars in the United States were made at the Harvard Observatory in 1850, and ever since the work has been continued, so that now the observatory has a file of thousands of plates which are not duplicated at any other institution.

Some of these are direct photographs, others are spectra, which reveal the composition of the stars and which were used in the compilation of the great Henry Draper Catalog. This monumental work lists over 225,000 stars, and gives their brightness, position, and spectral type. Most of the work on it was done between 1911 and 1924, largely by Miss Annie Jump Cannon, the first and only woman to receive an honorary degree from Oxford University, in England, which was conferred in honor of her scientific achievements.

YOUTH OF NATION ASKED TO FIND HEALTHY CHESTNUT TREES.

Chestnut trees of the future, if there are any, may owe their existence to the energies of some boy or girl of today.

The Department of Agriculture is receiving the aid of the youth of the land, particularly boy and girl scouts, in scouting out chestnut trees that are resistant to the blight that has wiped out most of the chestnuts of eastern American in the region north of Virginia.

G. F. Gravatt, of the Office of Forest Pathology, said that there is no means of saving the present growth of chestnuts. All hope is concentrated on the starting of a new growth of blight resistant trees. Some species have been introduced from China and Japan, but occasionally there is found a resistant native tree which is still sound in spite of the epidemic that has killed its companions.

Scouts have been asked to send in the location, size and condition of the healthiest trees which they find. This information will allow experts to examine the trees and as a first step toward possible reforestation nuts and grafted trees from the most promising will be planted in the experimental orchard at Bell, Md. for further testing. It is expected that arrangements will be made in cooperation with state authorities to give out seedlings from the most resistant trees to scouts to plant on their own camp grounds, so that chestnutting will not become a lost art to the youth of America.

PHOTO REVEALS PINCH OF HUNGER

Hunger is pain, according to Dr. F. T. Rogers of Baylor University, who has succeeded in taking an X-ray snapshot of his own stomach at the instant when he was experiencing sharp pangs of hunger.

Investigation under Dr. A. J. Carlson of the University of Chicago had proved that the stomach undergoes a violent contraction, lasting nearly a minute, when the gnawing sensation is felt following fasting. This was shown by the insertion into the stomach of a rubber balloon, joined by a tube leading up the gullet to a pressure gauge. At the instant the sinking feeling came on a hungry subject, the pressure rose, indicating the balloon was squeezed as the walls of the stomach flapped together.

Now Dr. Rogers has analyzed the process, using a new X-ray technic which enables him to photograph the air in the stomach and in the balloon lowered into it.

"The hunger contractions differ from the movements of the stomach during digestion," Dr. Rogers explained. "When food is in the stomach, a constriction starts about halfway, and passes downwards, thereby moving the contents along.

"But in the case of a hunger spasm, there is a circular contraction of the lower two-fifths of the stomach, which shrinks like a deflated balloon.

"The photographs reveal that the hungry stomach is drawn upwards, frequently right under the ribs."

The hunger convulsions cease whenever solid or liquid, even water, enters the stomach. This fact complicated the taking of the X-ray pictures, since barium sulphate or bismuth subnitrate, commonly put in the stomach to make it opaque to the X-ray, would also stop the sought-for contractions.

"The hunger contractions are more pronounced in infants than in adults," said Prof. Rogers. "Children cry when they are hungry because they are indeed in pain."

Losses in the Florida watermelon crop are being reduced by disinfecting the seed with bichloride of mercury.

TEST SHOWS WOMEN MORE IRRITABLE THAN MEN

That women are more irritable than men has been generally admitted, but a woman physiologist has now brought definite proof that this is so. Miss Emily Williams of the University of Illinois proved it by means of the knee-jerk test on 63 men and 70 women. This test, Miss Williams said, is considered a reliable index to the general body tone and irritability.

The women proved to be the highest kickers, it was found, and exceeded the men by 42 per cent. in the distance kicked. When a sharp blow of a little less than 2 ounces was applied to the knee ligament, the men kicked to an average height of not quite 14 inches but the women to more than 19 inches. The men, however, were more irregular, for both the highest and lowest kickers were found among them. The knee-jerk was absent in men much more frequently than in women.

"The knee-jerk is now used to diagnose injuries to the spinal cord," Miss Williams explained. "In the disease known as locomotor ataxia certain nerve tracts are injured and the jerk is lessened or lost altogether, depending on the severity of the disease. The same is true in infantile paralysis. According to the results of various investigators, practically any variation in the general bodily tone or irritability will be shown in the knee-jerk.

"One investigator found that the jerk was affected by exercise, cold baths, food, music and mental actitity. Another observed that hunger greatly increased the response. Two others, in studying the factors which increase and lessen the knee-jerk, noticed that any painful stimulation of the nerves as by pinching, burning, freezing, electric shock, or exposure of the eyes to the glare of a burning magnesium wire increased the distance of the kick.

"In this experiment," Miss Williams continued, "college students between the ages of 18 and 24 were used and all the tests were made on normal subjects under similar conditions. A uniform blow of 50 grams, or less than 2 ounces, was insured by means of a simple machine. Each subject registered about 100 kicks, and the results showed that women are definitely more irritable than men."

WHAT IS MAHOGANY? QUESTION NOW UP TO FEDERAL TRADE COMMISSION

When is mahogany not mahogany? The U. S. Federal Trade Commission is called upon to solve this riddle, which has more than a little commercial importance. There are a number of dark reddish tropical hardwoods that lay claim to this name, which came to mean in woods what "sterling" means on silver, not long after the discovery of America.

The first woods to be called mahogany were from the tree genus known to botanists at Swietenia. The five species in this genus have no common English names, and their wood is known simply by locality names, like "Honduras mahogany", "Cuban mahogany", etc. Woods of similar appearance, though not necessarily of the genus Swietenia, are marketed under the trade names of "Philippine mahogany", "African mahogany", and similar titles. The Federal Trade Commission is now trying to decide whether the use of the name "mahogany" should be restricted to the single genus that first made it popular, or whether it should be broadly interpreted to include all species now bearing it.

WOMEN'S FINGERS WORK FASTER THAN MEN'S

A method of measuring the speed in an individual's fingers has been devised. The test has been applied to 1,021 women applying for work in the shops of an electrical company and the results are described in a recent issue of the Journal of Personnel Research by Mildred Hines and Johnson O'Connor.

The equipment used by the experimenters consisted of nothing more than 300 brass pins and a flat metal plate in which 100 holes were drilled part way through. Candidates for work requiring agile fingers are asked to pick the pins from a tray in which they are piled loosely and to place three pins in each drilled hole in the plate as rapidly as possible. They are instructed to try to pick up the pins three at a time in order to make maximum speed. Individuals vary widely in this test. The fastest finish in less than six minutes and the slowest require from twelve to fifteen minutes.

Since the inauguration of this test seventy-seven new women workers have been assigned to the fine meter or instrument work requiring finger dexterity. Subsequent records show that more than 85 per cent of these women are successful in the work. The test also showed that women are much better adapted for this work than are men.

The test is said to eliminate much of the guess work and personal equation factor in the hiring of workers for this type of work.

TABLOID BOOK REVIEW

METHODS OF DESCRIPTIVE SYSTEMATIC BOTANY. By A. S. Hitchcock. New York: John Wiley & Sons, Inc. 1925. When you strike a citation in a botany book like this:"Arctostaphylos Uva-ursi" (L.) Spreng." or "Panicum flexile (Gattinger) Scribn., what does it mean? You may have been successful in a routine "keying out" of the plant in your hand; but how did the men work who gave it the name you have found, and by what authority did they give it that name, and why are their own names or abbreviations tacked on afterward, as a kind of seal? What do you really know about taxonomy, anyhow? Most of us don't know anything about it: we know the literature of botany or zoology (perhaps), but we don't know the grammar. Professor Hitchcock does for the present generation of young botanists what De Candolle did for those of the past, who were lucky enough to be able to read French readily; he gives us in compact and simple and readable form a book of the rules of the game of systematic botany. This small volume is one of the few books turned out recently that can honestly be called indispensable in every botanist's working library.

TNT mines have been used by the Coast Guard in the attempt to break up giant icebergs in the northern Atlantic.

How ice loads down a tree was shown by weighing pine needles: the ice laden branches weighed 13 times as much as the others.